SuperTest - keeping pace with LLVM compiler technology

As part of its DesignWare® IP portfolio, Synopsys offers a comprehensive range of 32-bit ARC® processor cores together with a corresponding set of optimizing compilers. However, the user configurability of these cores, both in terms of the ability to introduce or omit hardware blocks, adopt different memory schemes and add custom instructions to meet specific performance, power and area requirements, significantly complicates compiler testing. Mitesh Shah and Irena Phironova of Synopsys' compiler development team provide some insights into why they use the SuperTest compiler test and validation suite to ensure their compilers remain error free.

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"Our customers are very conscious of core size and our highly configurable ARC cores enable them to adjust configuration settings to reduce area for their specific requirements.. For example, you can have a multiplier or barrel shifter in or out, opt for a floating point configuration, configure different amounts of CCM or cache memory, and define the number of interrupts. But this flexibility poses a real challenge, because we need to make sure our compilers generate code that matches those configurations. As a result, we run our regressions across many different configurations to provide the proper coverage," says Mitesh Shah, Senior R&D Manager at Synopsys. "SuperTest provides the coverage we need in this cross-configuration testing. It also runs fast, so we don't have any problems with the compute time. We simply run SuperTest™ overnight as part of our daily test routine."

However, according to Mitesh, meeting Synopsys' test coverage and run-time requirements is not the whole story.

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For Irena Phironova, Verification Manager for Synopsys' ARC MetaWare Toolkit, SuperTest's ability to identify and isolate compiler issues also makes it a key weapon in keeping pace with rapidly changing compiler technology.

"The compilers for our ARC cores are based on LLVM[1] technology with a 'Clang LLVM' front-end, which means that we need to periodically synchronize with a new version of LLVM and cope with a new wave of potentially critical bugs," says Irena. "It's not just in the front-end that bugs can occur. Changes in the optimization paths at the back-end of our compilers can also create new problems. SuperTest identifies a lot of the issues, not only in the front-end but also in the back-end."

Irena even has figures to prove SuperTest's effectiveness.

"We have a bug reporting system that makes it very easy to track the source of each bug and the tool used to identify it, and when I analyzed all the reports over the last six months I discovered that SuperTest was responsible for finding around 10% of them. When you consider the overall size of our test frame that's a very high percentage for a single tool, making SuperTest one of the most productive tools we have," says Irena. "Many of these bugs are run-time failures, but SuperTest has also found a lot of the bugs in our LLVM front-end."

In addition to regression testing, Irena's ARC core team also uses SuperTest for functional testing and as a conformance test for C99 and C++. They also have plans to use it in other areas of compiler development.

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[1] www.llvm.org

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Our mission is to improve the quality of C and C++ compilers, and their safe and secure use by providing the best possible compiler validation suite. Due to the close relationship with the SuperTest users, their feedback on our updates and suggestions on how to improve, we continuously expand and renew SuperTest. With our knowledge of past, current and upcoming versions of the C standard, new analysis and optimizations techniques and new compiler use cases, Solid Sands stays at the fore-front of compiler testing and validation.

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